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Subject: NIST WTC Report Comments

To whom it may concern:

I am writing to comment on the NIST Draft Report on the WTC Investigation. While I believe that NIST has done an excellent job in covering many key areas of the tragic events surrounding the collapse of the Twin Towers, I also believe that a number of crucial issues have not been addressed. Therefore, although I would certainly like to adhere to the style of comment suggested on your website (i.e. chapter, page No, etc), please allow me to first provide a list of issues that I believe are still in need of investigation by NIST:

**1.** A topic that gets very little coverage in any of the NIST or FEMA documents dealing with the WTC disaster is the jet fuel explosions that accompanied both aircraft impacts with the Twin Towers. I believe that a detailed examination of these explosions is essential to a full understanding of the extent of the damage caused to the Twin Towers by the aircraft impacts. I would therefore like to see a Section in the NIST Report that addresses key questions surrounding these explosions. For example:

- What was the source of the bright flash close to the point of impact of the aircraft as it struck the south face of WTC 2?
- What ignited the fireballs within the Twin Towers?
- Were the fireballs the result of a fuel deflagration or detonation within each Tower?
- How much energy was released in the air-fuel explosions?
- What was the blast overpressure of the explosions?

**2.** In mechanical terms, the aircraft strikes on the Twin Towers involved a collision between two metal frame structures, one made mainly from aluminum and the other made mainly from steel. Such collisions are modeled quite effectively using calculations based on the mechanical properties of the structural members involved. (See for example Appendix C of the NIST Interim Report.) But not included in these "engineering calculations" are the *chemical interactions* that came into play during and after the aircraft impacts – interactions that are specific to the combination of materials present in the damaged Twin Towers, namely, aluminum, steel, concrete and jet fuel. The Colorado School of Mines recently published a report, (No. MT-CWJCR-002-024), entitled "*Feasibility of Thermite Sparking with Impact of Rusted Steel onto Aluminum Coated Steel.*" This study shows that intense, thermite-induced, sparking occurs between relatively small (~ 100 gram) aluminum and rusty steel projectiles at impact velocities as low as 12 m/s. In light of these findings there can be no doubt that thermite-enhanced sparking occurred within the Twin Towers when the Boeing 767 aircraft, traveling at about 200 m/s, struck the perimeter and core columns. This is highly significant for a number of reasons. First, it provides a source for the bright flash close to the point of impact of the aircraft as it struck the south face of WTC 2. Secondly, it provides a mechanism for a deflagration-to-detonation transition within the fuel vapor clouds that formed in the Twin Towers immediately after the aircraft impacts.

**3.** The physical and chemical behavior of the concrete in the WTC is not covered in sufficient detail in the NIST report. For example, the pulverization of the WTC concrete to a fine dust is not considered at all. It is well known that the removal of water from concrete results in irreversible changes to the microstructure of the material that has deleterious effects on its strength. Thus, when the temperature of concrete is raised to 250° C, up to 75 % of the stoichiometric mass of water is lost and the compressive strength of the material declines. Studies conducted by researchers at NIST, (See NIST Report No.

6475, March 2000), have shown that in the temperature range from 240° to 280° C, *explosive spalling* of some concrete specimens occurs due to the rapid release of chemically bound water. This process may well have occurred in regions of the Twin Towers exposed to fires. While the NIST Report does mention the formation of *molten aluminum* in the Twin Towers just prior to their collapse, the possibility of the explosive spalling of concrete by reaction with aluminum is not considered

**4.** Examination of photographs of the remains of the Twin Towers after the events of 911 shows that most of the core and perimeter columns in the debris field were *not* severely buckled. On the other hand, fracture of A325 bolts at the column splice plates appears to have been a common failure mode. This suggests that the strength of the column connecting bolts was *not* well matched to the strength of the column members they were designed to hold. It would therefore appear that the A325 connecting bolts failed before the full strength of many of the columns was realized, explaining why most of the columns were not severely buckled. While the NIST *Interim Report* provides some information on the behavior of A325 bolts used in the WTC, (See for example, Appendix C, page C-30), a comparison of the energy dissipated within the bolts and the core columns during the collapse of the Twin Towers is not presented; details on the number and layout of the bolts used for the core column splices would be of value in this respect.

**5.** It would be useful to see detailed energy transfer calculations of the collapse of each of the Twin Towers as part of the NIST Report. I have made some preliminary studies of this topic using a stepwise momentum transfer calculation for each floor and determined that the collapse of WTC 1 took 12.6 seconds, and WTC 2 took 11.5 seconds. Thus it is possible to follow the detailed *floor-by-floor* progress of the collapse of each WTC tower and show how the delay in the fall of each tower develops compared to the free-fall of an object from 416 meters, which takes about 9 seconds.

Finally, I would like to comment on one specific topic that *is* included in the NIST Report. This is the write up on sample K-16 as described in NCSTAR 1-3C, starting on page 229. Figures 6-20 and 6-23 certainly show a badly corroded column, but I have problems with NIST's proposal that sample K-16 was subject to erosion/corrosion *as a result of exposure to high temperatures from the WTC fires*. I say this for the following reasons:

(1) Although investigators are not sure of the precise origin of the column from which K-16 was cut, NIST note that it is of type 143, a column that was only used *below* the 53rd floors in each tower. The problem with this is that there were no major fires in this lower portion of the Towers.

(2) I also have problems with the *appearance* of the column. It does not look like it was exposed to a fire. There are no scorch marks or sooty deposits. Photographs of the WTC fires show fuel-rich, smoky flames. I would expect to see black deposits on K-16 if it had been exposed to the WTC fires, but the area where the sample was cut (see Fig. 6-23) is pretty much reddish-brown and looks like air/water-formed corrosion deposit, i.e. common rust.

(3) The micrographs provided by NIST (e.g. Fig 6-21) show an oxide scale on K-16 that is 100 microns or more in thickness. NIST also provide a micrograph, Figure 6-8, that shows only about 20 microns of oxide growth on HSLA steel *after 2 hours at 625 degrees C.* Since the WTC fires typically lasted less than 1 hour at any location, and the average temperature at the location was probably less than 625 C, it is very unlikely that the WTC fires could have produced 100 micron oxide scales as proposed by NIST.

In conclusion, I once again commend NIST for the excellent work its researchers have completed to date. I certainly hope my comments are of use.

Sincerely,

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